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ABSTRACT

The study examined modality effects in the learning of Braille through providing a variety of either study or test trials in either the visual or haptic modalities. Subjects were 144 right handed college students. Results supported previous experiments demonstrating the visual modality superior to the combined visual-haptic or the haptic modality alone in the learning of Braille symbols. However, the visual-haptic condition was superior to the haptic-visual study-test ratio condition. Better performance occurred for those who studied visually and for those who were tested visually. Other findings were that performance was inversely related to item complexity. Results tended to support a modified modality adeptness hypothesis which related performance to frequency of presentation in the most adept modality. (DB)

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Modality Effects in Braille Learning

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(Presented at meeting of Psychonomic Society, Chicago, November, 1988)

Several years ago, as some of you may remember, we began a program of research on the perception, learning and remembering of braille. One of the tasks we used took the form of a paired-associate task in which subjects learned the letter names for symbols of the braille alphabet. In one of our early experiments (Newman, et al., 1982) testing what appeared to be an implication of what was then called the encoding specificity hypothesis (Thomson & Tulving, 1970), we used a 2 x 2 between-subjects design in which subjects studied the braille symbols haptically or visually and were then tested haptically or visually. The findings were that those who studied the items visually and were tested visually did significantly better than the two crossmodal groups, and they, in turn, did significantly better than those who studied the items haptically and were tested haptically. Anthony Hall and I replicated these findings in another experiment more recently (Hall & Newman, 1987).

One explanation for these results derives from what David Freides (1974) has called the modality adeptness hypothesis and what Robert Welch and David Warren (1980) refer to as a "modality appropriateness" position. According to Freides, the subject translates each item into a code for the modality which is the most adept for the task to be performed. The more frequently items are presented in the most adept modality, whether on study trials or test trials, the better performance will be. Since, according to Freides (Personal Communication, May 25, 1981), the visual modality is more adept than the haptic modality for this task, the order of means that we obtained in our experiments, that is, from Visual-Visual, to mixed modes, to Haptic-Haptic, is the one to be expected.

In both of our previous experiments we employed the usual procedure of alternating study trials and test trials. Thus, there were the same number of study trials and test trials. However, in the study we are reporting today, we compared that procedure with two others in which the number of study trials or the number of test trials predominated. Thus, all subjects were given six trials, either 5 study trials and 1 test trial, or 1 study trial and 5 test trials, or they were exposed to the usual procedure of 3 study trials alternating with test trials. In addition, we varied both the study modality and the test modality. This enabled us to determine whether the order of the means we observed in our two previous experiments would be replicated

under these different conditions; concomitantly, this allowed us to test the modality adeptness hypothesis under a new set of conditions. Thus, this experiment can be considered a replication and extension of what we did before.

Method

Here, now, more specifically, is what we did. All subjects were given six trials to learn the names for braille symbols for the first ten letters of the alphabet. These are shown in Figure 1. The design of this experiment was a 2 x 2 x 3 between-subjects design in which the independent variables were the study modality (either visual or haptic), the test modality (either visual or haptic) and the study trial-test trial ratio, either 5:1, 3:3 or 1:5. On study trials subjects examined the braille symbols visually or haptically, and were told the letter name for each symbol as it was presented. On test trials, the symbols were examined visually or haptically, and the subject was to respond orally with its letter name. The items were presented at a 5-sec rate on both study trials and on test trials. In the haptic conditions, subjects examined each symbol using the index finger of the right hand. On these trials visual examination of the symbols was, of course, precluded. All subjects were told the modality for their test trials before training was begun. Subjects in the 1:5 condition were given one study trial followed by five test trials; those in the 5:1 condition had five study trials followed by one test trial, and those in the 3:3 condition had alternating study trials and test trials. For all conditions the items appeared in a different order on each trial and two sets of orders were used, one set for half of the subjects in each treatment.

The subjects were 144 students enrolled in the introductory psychology course at North Carolina State University. All were right-handed. They were assigned to treatments using a counterbalancing procedure, and were run individually. There were 12 subjects, six male and six female, in each of the twelve treatments.

Results and Discussion

The main dependent variable was the number of correct responses on the sixth trial, which was a test trial for all subjects. The means for all treatments are presented in Table 1.

An analysis of variance was applied to these data and showed that all three of the main effects as well as the interaction of study modality and test modality were significant, each at the .01 level. Examination of the means for study-test ratio showed that both the 5:1 and 3:3 groups did better than the 1:5 group ($p < .05$). Furthermore, for both the study trials and the

test trials, better performance occurred for those who studied visually and for those who were tested visually. Finally, those in the Visual-Visual condition did better than those in the other three conditions, and the Visual-Haptic mean exceeded the Haptic-Haptic mean. Examination of the means in Table 1 shows also that for each of the study-test ratios the order of the means was from Visual-Visual to Visual-Haptic to Haptic-Visual to Haptic-Haptic which is the same order that occurred in our two previous experiments. Thus, these results appear to accord with the modality adeptness hypothesis. The superiority of the Visual-Haptic to the Haptic-Visual treatment at each of the study-test ratios suggests, however, as do similar results from our previous experiments (Hall & Newman, 1987; Newman, et al., 1982) that some modification of the hypothesis is necessary to take account of the differing contributions of study trials and test trials.

There are two other findings on which we will comment briefly - the change in performance during the five successive test trials for those in the 1:5 condition, and the relationship between item difficulty and item complexity. For subjects in the 1:5 condition we looked at the number of correct responses on Trials 2, 3, 4, 5 and 6 and applied an analysis of variance to these data. Although the effects of study modality, of test modality and their interaction were all significant ($p < .05$), we were especially interested in the fact that the effect of trials was also significant ($p < .05$) as was the interaction of study modality and trials. Examination of the means shows that performance increased slightly for those who studied the items haptically and somewhat more so for those who studied the items visually, a suggestion, perhaps, of hypermnesia (Erdelyi & Becker, 1974).

Finally, we looked at the relationship between item complexity (as indicated by the number of dots each item contains) and the number correct for that item on Test 6. We did separate correlations for each of the 12 groups. All 12 were negative and three of these were significant ($p < .05$). The correlations ranged from -.29 to -.71. Thus, as might be expected, and as we have found in previous experiments on learning (Newman, Hall, Foster & Gupta, 1984), on perception (Newman, Craig & Hall, 1987), and on immediate memory (Newman, Brugler & Craig, in press), performance was inversely related to item complexity.

The results of this experiment indicate that subjects perform better when they study the items visually and when they are tested visually. To that extent the results support the modality adeptness hypothesis. However, the results of this experiment suggest also that the modality adeptness hypothesis should be modified to take account of the differing effects of study trials and of test trials.

Authors' Note

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Table 1

Mean Correct Responses for Each Treatment

	Study Modality - Test Modality			
Study-Test Ratio	Visual-Visual	Visual-Haptic	Haptic-Visual	Haptic-Haptic
1-5	8.2	5.3	3.7	3.1
3-3	9.3	6.7	5.8	5.2
5-1	8.5	6.1	5.7	5.1

A B C D E F G H I J

Figure 1. The First Ten Letters of the Braille Alphabet